Implementation Monitoring of Forestry Best Management Practices for Harvesting And Site Preparation in South Carolina, 2001-2003

Best Management Practices

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of

Forestry Best Management Practices

For Harvesting and Site Preparation in South Carolina 2001-2003

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Executive Summary

A sixth survey was conducted to determine compliance with BMPs related to timber harvesting and site preparation in South Carolina. 300 sites were evaluated over a 3-year period, and each site was rated for compliance in several categories of BMPs, including forest road construction, stream crossings, streamside management zones, timber harvesting systems, mechanical site preparation, chemical site preparation, prescribed burning, and minor drainage. Overall compliance with BMPs related to harvesting rose to 94% during this survey, and overall compliance with BMPs related to site preparation fell slightly to 96%. Major problems noted on inadequate sites were poor road and stream crossing design, lack of stabilization on forest access roads and stream crossings, insufficient protection of the streamside management zone, and the use of mechanical site preparation techniques on steep slopes.

Introduction

Since *South Carolina's Best Management Practices for Forestry* was published in 1994, six surveys have been conducted to determine BMP compliance rates when silvicultural activities are conducted. Four of these surveys documented compliance with BMPs related to timber harvesting. Overall compliance with harvesting BMPs was 84.5% in 1990, 84.7% in 1991, 89.5% in 1994, and 91.5% in 1997, the most recent survey. Monitoring of BMPs for site preparation was conducted twice, with implementation rates of 86.4% in 1996 and 98% in 1999. The current study was designed to determine current implementation levels for BMPs relating to both harvesting and site preparation.

The surveys conducted in 1991-1996 were based on a single site visit to each monitoring site. The previous survey, published in 2000, was based on a series of annual visits to monitoring sites to determine compliance for both harvesting and site preparation activities. During the initial site visit, compliance with BMPs related to timber harvesting was determined. During subsequent site visits, at both one year and two years post-harvest, compliance rates were determined for BMPs related to site preparation. This survey was designed to replicate the study conducted in 1997-1999.

During this BMP compliance survey, sites were located and an initial site visit was made to determine compliance with BMPs related to timber harvesting. One year after the harvest, each site was visited again, and each site that received site preparation treatments was evaluated for compliance with BMPs related to site preparation. Two years after the harvest an additional site visit was conducted, and sites that received site preparation treatments in the intervening year were evaluated for compliance with site preparation BMPs. To improve the statistical accuracy of the monitoring results, an additional 100 recently site prepared sites were also located and evaluated for compliance with site preparation BMPs during the second year of this three year survey.

Timeline for Monitoring Site Selection and Evaluations

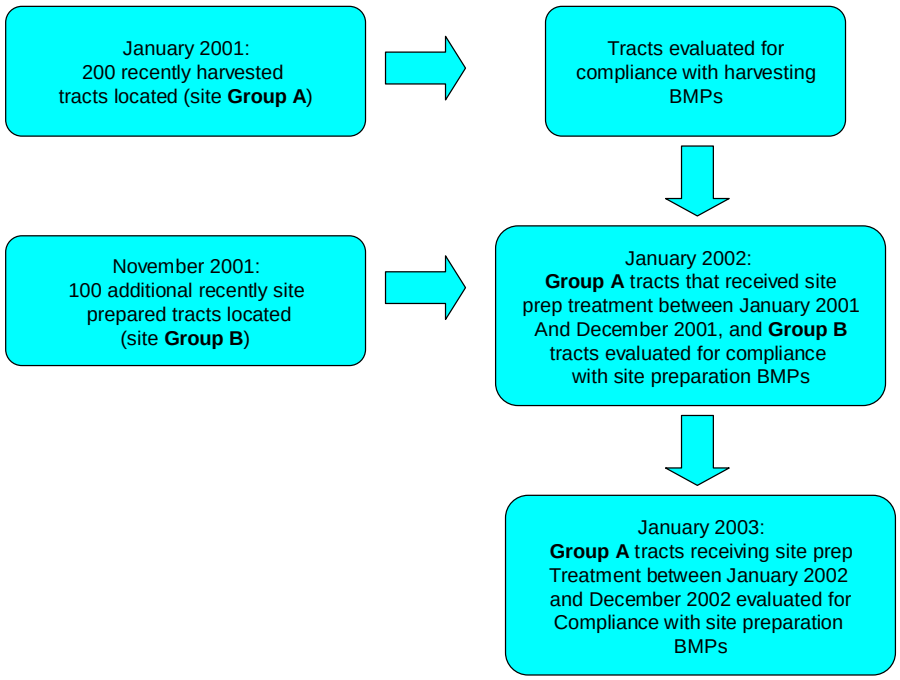

Figure 1: Flow chart detailing timeframe for selection and field visits to sites included in this survey.

Harvesting BMP Compliance: Study Methods

During January of 2001, two hundred recently harvested sites were located during an aerial survey utilizing a GPS in small, fixed-wing aircraft. The number of monitoring sites in each county was determined based on annual timber harvest data collected by the US Forest Service. Timber product output for each county was determined, and the number of sites located in each county was based on the proportion of wood harvested in that county in relation to the entire state. Specially trained BMP Foresters conducted an aerial survey of each county and located at least twice as many monitoring sites as were necessary. Within each county, the program coordinator utilized a random number generator to determine which sites from among the pool of candidate sites were chosen for inclusion in monitoring.

Aerial surveys were utilized to remove bias during site selection. This monitoring survey was designed to sample sites from among all landowner classes, physiographic regions, soil types, and management regimes. Harvested sites selected for inclusion in monitoring were at least 10 acres in size, had been harvested within the previous six months, and were evaluated on the ground before any site preparation activity occurred. No

association with streams or wetland areas was required to be included as a monitoring site.

Landowner Questionnaire

Once a site was selected for inclusion in monitoring, the BMP Forester contacted each landowner to obtain permission to visit the site. Prior to the site inspection, each landowner was questioned concerning their level of familiarity with forestry BMPs, use of a professional forester, and use of a written contract. Four categories of landowners were identified for the purpose of this study:

1. Non-industrial private landowners who own less than 1,000 acres of forest land.
2. Non-industrial private landowners who own more than 1,000 acres of forest land.
3. Public lands, including both state and federal lands.
4. Industrial lands, owned by forest products companies and timberland investment groups.

BMP Compliance Inspection; Harvesting

Site inspections were made during the winter of 2001. The field evaluations were made by the BMP forester and the project forester. Each major category of BMPs was evaluated on a pass/fail basis depending on the responses to a series of yes/no questions related to successful implementation of each BMP. BMP compliance was evaluated in each of five categories:

1. Road Systems
2. Road Stream Crossings
3. Streamside management zones (SMZs)
4. Log decks
5. Harvesting systems

Overall BMP compliance for each site was determined after all individual BMP categories were fully evaluated. Each site was given an overall rating of excellent, adequate, or inadequate depending on the level of BMP compliance. The criterion for each overall compliance rating is as follows:

> **Excellent compliance:** All recommended BMPs were implemented successfully, and no water quality impacts resulted from the harvesting operation. Significant additional steps were taken to stabilize the site, reduce impacts to water quality or site quality, or to mitigate aesthetic impacts of the harvest.
>
> **Adequate compliance:** Recommended BMPs were implemented successfully, and no water quality impacts resulted from the harvesting operation.

Inadequate compliance: All recommended BMPs were not implemented or were implemented without success. Likely water quality impacts were noted as a result of poor or improper BMP implementation.

Monitoring Results: Harvesting

Field visits to evaluate compliance with BMPs related to timber harvesting were conducted in early 2001. Compliance for each of the five major BMP categories and overall BMP compliance is summarized as follows.

91.8% Acceptable
Road Systems

Roads were constructed to provide access for forest management activities on 61 of the 200 sites that were evaluated. During the field evaluation, BMPs for road construction and stream crossings on forest roads were considered separately. Of the 61 sites that included forest road construction, 5 were rated as unacceptable. Four of the unacceptable sites were located on upland clay hills, and one was located in a bottomland hardwood area. These sites located in upland clay hills were rated as unacceptable due to a lack of stabilization (insufficient or poorly constructed water bars and turnouts) and poor road design. The bottomland hardwood site received an unacceptable rating based on poor road design, lack of stabilization of exposed soil, and excessive fill in a wetland. Compliance with BMPs relating to forest road construction was lower than the 98.6% level of compliance reported in the last survey (Jones, 2000).

Figure 2: Haul road stabilized with vegetative cover.

77.8% Acceptable
Road Stream Crossings

In this survey, 18 of the 200 sites surveyed for compliance with BMPs related to timber harvesting involved the construction of haul road stream crossings. Of these 18 stream crossings, 14 were designed, constructed, and maintained in compliance with BMPs. Four of the 18 sites were rated as unacceptable. Deficiencies noted with the stream crossings on the unacceptable sites included insufficiently sized culverts, lack of stabilization at the stream crossing, and poor stabilization on the approaches to the road stream crossing. Compliance with BMPs related to haul road stream crossings was somewhat lower in this survey than in the previous survey, where compliance was 86.7% (Jones, 2000).

Figure 3: Poorly installed culvert on a haul road.

87.3% Acceptable
Streamside Management Zones

Perennial or intermittent streams were present and streamside management zones were necessary on 118 of the 200 sites included in this monitoring survey. Of these 118 harvesting operations, appropriate SMZs were retained on 103 sites. On fifteen sites, the SMZs were rated as unacceptable because forested SMZs did not meet the criteria recommended in the BMP manual. Unacceptable ratings were given when the SMZ was completely harvested (10 sites), when insufficient overstory basal area was retained within the SMZ (5 sites), woody debris was left in the stream (4 sites), and when log decks or excessive vehicle traffic resulted in excessive bare mineral soil exposure within the primary SMZ (3 sites). Compliance with BMPs related to the streamside management zone was higher in this survey (87.3%) compared to 83.7% in the last survey (Jones, 2000).

Figure 4: The SMZ was harvested adjacent to this perennial stream.

93.5% Acceptable
Logging Systems

Application of the BMPs related to the harvesting operation was evaluated on each of the 200 sites included in this survey. Of these, 187 sites were rated as acceptable. When examining the logging systems on each site, the following areas were evaluated: (1) log deck location, (2) skid trail design location, (3) skid trail stream crossing design and location, (4) degree of rutting, (5) percent of the area affected by skidding equipment. A lack of stabilization on primary skid trails was the most common deficiency in BMP implementation, occurring on 8 sites. Other problems noted include poorly designed skid trail stream crossings (7 sites), poor location of skid trail stream crossings (5 sites), and placement of primary skid trails within the primary SMZ (3 sites). Compliance with BMPs related to timber harvesting was higher in this survey than the 89% compliance reported in the previous survey (Jones, 2000).

Figure 5: Poorly designed skid trail crossing left in place.

OVERALL BMP COMPLIANCE: HARVESTING 94% Adequate

In this survey, overall compliance with BMPs related to timber harvesting in South Carolina was 94%, compared to 91.5% in the 1997 survey. Of the 200 sites inspected during this survey, 10 sites were rated as excellent, 178 were rated as adequate, and 12 were rated as inadequate. Eight of the sites receiving an inadequate rating were located on upland clay hills (piedmont) terrain type, while two were located in bottomland hardwood areas, and one was located in the sand hills.

On sites that were rated as inadequate, one or more BMPs were not implemented or were implemented incorrectly. As a result of deficiencies in BMP implementation, evidence was seen of a water quality impact. Examples of documented evidence of a water quality impacts include sediment trails reaching a perennial or intermittent stream, algae blooms in a perennial or intermittent stream, and excessive logging debris within a stream channel. In general, BMPs related to skid trail stream crossings and prescribing the appropriate amount of SMZ protection appear to be the most difficult areas to apply correctly. Specific deficiencies in BMP implementation noted on sites that were rated as inadequate include:

- Poorly designed skid trail stream crossings, including installing too many stream crossings, leaving temporary stream crossings in place, and poor stabilization at the crossing location (9 sites).
- Harvesting the SMZ on perennial streams (6 sites).
- Lack of directional felling during the harvest, resulting in excessive logging debris in perennial and intermittent streams (6 sites).
- Skid trails located within the SMZ and/or poorly located, and poor stabilization on skid trails (6 sites).
- Other deficiencies noted included poorly stabilized haul roads, log decks located within sensitive areas, poorly designed road stream crossings, fuel/oil spills at the logging deck, and retaining insufficient overstory basal area within the primary SMZ on perennial streams.

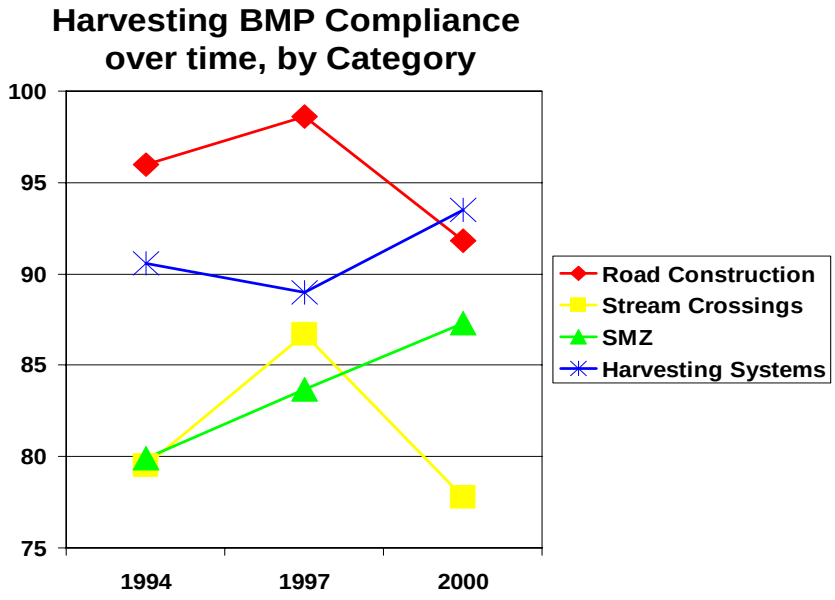

Figure 6: Compliance with harvesting BMPs, by category, over time.

Site Preparation Monitoring: Study Methods

In the previous monitoring study, published in 2000, 200 sites were evaluated for compliance with BMPs related to harvesting. Sequential site visits to the same 200 sites were conducted at one year after the harvest and at two years after the harvest. Evaluations were conducted to determine compliance with site preparation BMPs if any

reforestation activity occurred between visits. During this previous study, approximately ½ of the monitoring sites received some form of site preparation treatment during the two years following the harvest, resulting in a small sample size.

To increase the statistical accuracy of site preparation monitoring results, additional sites were included in this survey, as follows:

- Initial field visits to 200 monitoring sites were conducted in January 2001 to evaluate compliance with BMPs related to timber harvesting.
- In November/December 2001, 100 recently site prepared tracts were located.
- In January 2002, site visits were conducted to the initial 200 sites selected for evaluation for harvest monitoring and the 100 recently site prepared tracts. During this visit, a site preparation compliance inspection was conducted on each tract that received site prep treatments within the past year.
- In January 2003, any tract receiving site prep treatments during the previous year was evaluated for compliance with site prep BMPs.

Monitoring Results: Site Preparation

One hundred and eighty-eight (188) sites were evaluated for compliance with BMPs related to site preparation. Each site was evaluated for each type of site preparation treatment received, including mechanical, chemical, prescribed burning, and minor drainage.

90.4% Acceptable
Mechanical Site Preparation

One-hundred and four (104) sites received mechanical site preparation treatments. Various combinations of site preparation were documented in this survey. The most common type of mechanical treatment utilized was shear/rake/bed, followed by shear/chop/bed, shear/rake/disk, v-blade, and scalp/rake. Mechanical treatments were implemented on 55% of all monitoring sites that received some form of site prep treatment.

Four sites were rated as inadequate in the mechanical site preparation category. The most commonly noted problem was mechanical site preparation that was not done following the contour. Other problems noted were mechanical site prep on steep slopes with no untreated strips, excessive amounts of soil in windrows, gullies that were not protected. On one site, planting beds were constructed higher than necessary and planting beds were directly connected to ditches, raising concerns that wetland drainage may occur as a result.

98.3% Acceptable
Chemical Site Preparation

Fifty-nine (59) sites in this survey received some level of chemical site preparation. Of these sites, one (1) was determined to have unacceptable compliance with BMPs related to chemical site preparation. On this site, herbicide was applied to a cypress/gum pond where surface water was present.

Chemical methods were used on 23% of all sites that received some form of mechanical site preparation. The use of chemical treatments was most common (24 sites) on lands owned by small, private non-industrial forest landowners (owning <1,000 acres).

92% Acceptable
Prescribed Burning

Twenty-four (25) sites in this survey used prescribed fire for site preparation, either alone or in combination with other methods. The prescribed burns on the sites did not cause any water quality impacts, but on two sites (2) problems were noted with BMPs related to firebreak construction. On both of these sites, a lack of stabilization on firebreaks resulted in runoff being directed into intermittent streams, and a bladed firebreak was located within the primary SMZ on one of the sites.

Prescribed burning was most often used in combination with herbicide treatments, occurring on 22 sites. A combination of mechanical site preparation and prescribed burning was used on two sites, and prescribed burning alone was used on one additional site. Most sites that utilized prescribed burning were owned by non-industrial private landowners (20 sites), four sites were owned by forest industry and one publicly owned site.

Figure 7: Bladed fireline with water bars installed.

OVERALL BMP COMPLIANCE: SITE PREPARATION 96% Acceptable

Overall compliance with site preparation BMPs in this survey was 96%, compared to 98% in the 1999 survey and 86.4% in the 1996 survey. Of the 188 sites receiving treatments, 15 sites rated excellent, 166 sites rated adequate, and 7 sites rated inadequate. Two of the inadequate sites were located in the piedmont physiographic region of the state, one was located in the sandhills physiographic region, and four were located within the coastal plain.

Most deficiencies in BMP implementation resulted from utilization of mechanical site preparation on moderate to severe slope. On several sites, mechanical site prep did not follow the contour of the land, resulting in the creation of rills. Other problems noted were inadequate protection of gullies when conducting mechanical site prep, excessive amounts of soil placed in windrows, and chemical application within the primary SMZ. On one site, minor drainage ditches were installed in a wetland that connected directly to ephemeral and intermittent streams, possibly resulting in the conversion of this site from a wetland to an upland.

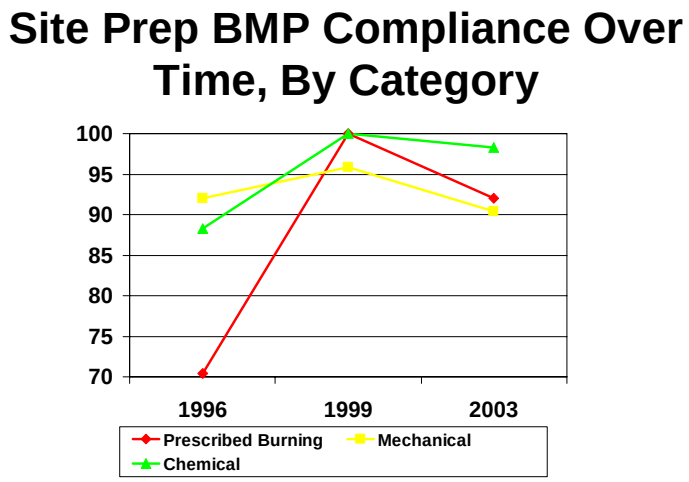

Figure 8: Compliance with site preparation BMPs over time, by category.

Conversion

Within this monitoring period, the presence of conversion was noted during each site visit. Conversion of a significant portion of the tract (>50% converted) was noted on 3% of the sites (6 sites out of 200) to uses other than silviculture. Of these, 5 were converted to residential/commercial use and 1 was converted to pasture.

Summary and Discussion

During this monitoring survey, 200 sites were initially selected and evaluated for compliance with BMPs related to timber harvesting. After one year, an additional 100 recently site prepared tracts were selected, and an evaluation was conducted on all tracts (200 initially selected plus 100 recently site prepared tracts) to determine compliance with BMPs related to site preparation. Each site was visited annually, and any forestry practices implemented during the year were evaluated for BMP compliance. The 100

additional recently site prepared tracts were included in this survey to improve the sample size for site preparation monitoring.

Overall compliance with silvicultural BMPs related to timber harvesting was 94% in this survey. Each of the four major categories of BMPs was evaluated during the initial site visit: road systems, road stream crossings, streamside management zones, and harvesting systems. Compliance was highest for BMPs related to harvesting systems, 93.5%. This category includes log decks, skid trail design & placement, skid trail stream crossings, and site rehabilitation.

Road stream crossings had the lowest compliance among the BMP categories, 77.8%. Of the 200 sites initially evaluated in this survey, haul road stream crossings were only constructed on 18 sites. Four of these sites were rated as having unacceptable BMP compliance. Problems noted with road stream crossings incorrect culvert sizes and poor stabilization at the crossing and on the approaches to the crossings. The small number of haul road stream crossings on the surveyed sites may actually indicate that harvest planning has improved, and construction of stream crossings is being avoided where possible.

Most of the sites (119 sites, 59%) included in the harvest monitoring survey were owned by non-industrial private individuals that own/manage >1,000 acres. Forest industry owned 64 sites (32%) in the survey, while non-industrial private landowners owned 15 sites (8%). Two sites (1%) of those included in this survey were owned by public entities, including state forests.

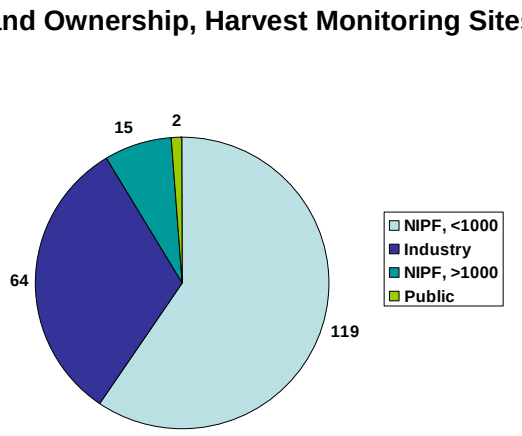

Figure 9: Land ownership for sites evaluated for compliance with BMPs related to timber harvesting.

Two-thirds (9 sites, 66%) of the sites receiving an inadequate rating were owned by non-industrial private landowners with >1,000 acres. One-third (3 sites, 33%) of the inadequate sites were owned by forest industry.

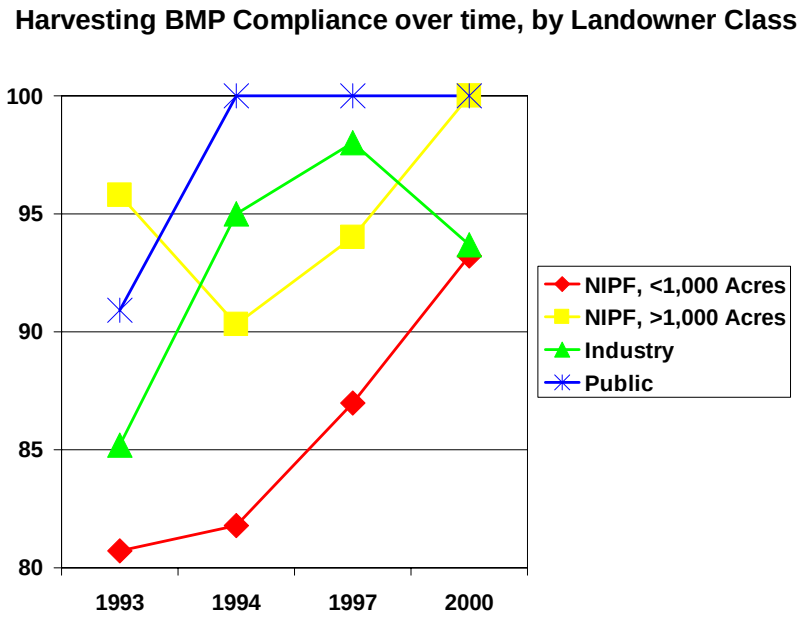

Figure 10: Compliance with BMPs related to timber harvesting over time, by landowner type.

While overall compliance with BMPs related to water quality rose somewhat during this survey, implementation rates within several of the broad categories of BMPs fell. There are several potential reasons for this trend:

- Liquidation of land by many forest products companies has occurred in the last several years. BMP compliance has traditionally been very high on industry-owned lands because foresters prescribe, oversee, and monitor silvicultural treatments. As these lands are sold, management objectives for these properties often change, and oversight by registered foresters may be less common.
- Lower compliance rates on lands owned by forest industry may reflect reduced staffing levels within forest products companies. With fewer foresters and forestry technicians, oversight of silvicultural activities may be decreased.
- Fluctuation in value of forest products can directly influence the amount of attention given to BMP implementation on logging sites.
- During this monitoring cycle (2001-2003), an ongoing severe drought may have allowed access for harvesting into areas that are normally too wet for traditional logging systems.

Most sites receiving inadequate ratings for BMP compliance (9 sites, or 66% of the sites rated as inadequate) were located upland clay hills, a terrain type that can increase the difficulty in correctly applying the BMPs. In this terrain type, the slope (generally >10%) and the soil type (erosion-prone clay soils, easily compacted) require attention to soil moisture, aspect, and site stabilization to reduce the amount of soil movement during and after the harvesting operation.

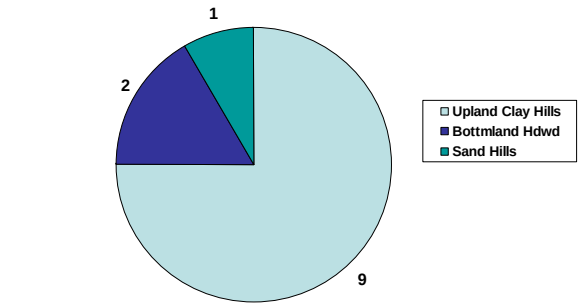

Figure 11: Terrain type, harvest monitoring sites receiving inadequate ratings.

In this survey, overall compliance for BMPs related to site preparation was 96%. Mechanical site preparation was the most common method noted during this survey, occurring on 55% (104 out of 188) of the sites. Chemical methods were used less frequently (31% of the sites, 59 out of 188). The mechanical site preparation category was the lowest rated BMP category, with 90.4% acceptable compliance. The problems noted with mechanical site preparation included not following the contour, utilized mechanical methods on steep slopes, and a lack of protection of gullies within the site prep area. The chemical site preparation category had the highest compliance at 98.3%.

The average harvest size for monitoring sites in this survey was 59 acres.

Minor drainage can be used as part of an ongoing silvicultural operation to remove excess surface water to facilitate access and regeneration. Because of the silvicultural exemptions under Section 404 of the Clean Water Act, minor drainage for silvicultural purposes does require a permit, but minor drainage may not be used to convert a jurisdictional wetland to an upland.

Of the 200 tracts evaluated for compliance with BMPs related to harvesting, 190 were harvested by loggers that met SFI training requirements at the time of harvest. Eleven (11) of the sites that received inadequate ratings were harvested by trained loggers.

Three sites included in this survey utilized minor drainage, either alone or in combination with other site preparation methods. On two monitoring sites, minor drainage was the only site preparation treatment applied during this monitoring period. One site used minor drainage in

combination with shear/rake/bed treatment. Minor drainage ditches were installed correctly on two monitoring sites and incorrectly on one monitoring site. On this site, ditches in wetlands tied directly into ephemeral and intermittent streams, and spoil piles were placed continuously along one side of the ditch, impeding overland flow and natural drainage across the site. In addition, portions of a perennial stream were channelized during the site prep operation.

Recommendations

Since regular monitoring of BMP implementation began in South Carolina in 1990, overall BMP compliance has continued to improve. Many factors have contributed to the increased compliance with and awareness of forestry BMPs:

- On the ground educational efforts through the SCFC Courtesy BMP Exam program
- Increased availability of training for loggers, foresters, and forest landowners
- Targeted training to address areas of historically low BMP implementation
- Improved consistency when enforcement actions are initiated
- Improved cooperation between state agencies, federal agencies, and private organizations (SCFC, SCDHEC, EPA, SCFA, Clemson University)
- Support from companies that participate in the Sustainable Forestry Initiative
- Increased professionalism in the logging community
- Improvements in the BMP Manual (addition of the Braided Stream BMPs)

In cooperation with the South Carolina Forestry Association, logger training through the Timber Operations Professional (TOP) Logger program has been in place since 1994. Initial training through TOP Logger provides participants with a basic understanding of BMPs, and subsequent training provides opportunities for more in-depth training. As a result of problems noted in past monitoring surveys, additional workshops have been created to address BMPs for the streamside management zone, harvest planning, and forest road construction. Continuation of this program and participation by forest industry is essential to further improve compliance with BMPs.

Courtesy BMP Exams are offered to active forestry operations located by specially-trained BMP Foresters through aerial observation, voluntary notification, or complaints. During a Courtesy BMP Exam, the BMP Forester visits the site while the silvicultural operation is ongoing and provides the operator with site-specific recommendations to properly implement BMPs on the tract. Upon completion of the operation, the BMP Forester examines the site, and the operator is given an opportunity to correct any deficiencies that exist. When excessive damage has occurred, resulting in a likely water quality impact, deficiencies are noted on the monthly Courtesy Exam Report. Through this report, the site is referred to the SC Department of Health & Environmental Control for possible enforcement action, and to forest industry. Forest industry utilizes the report to determine when corrective action and additional training is necessary for their suppliers.

In order to improve BMP compliance, the following suggestions should be implemented:

- Future monitoring surveys should follow more closely the protocol established for BMP monitoring by the Southern Group of State Foresters Water Resources Committee.
- BMP educational programs (TOP Logger) should continue to be offered regularly and with minimal cost to forestry operators.
- Existing and new training programs should target areas where BMP compliance has historically been low- streamside management zones, harvest planning, mechanical site preparation, and stream crossings.
- The Courtesy BMP Exam program should be continued. This preventative program provides opportunities for one-on-one training for loggers, road construction contractors, and site preparation contractors. Follow up by SCDHEC and forest industry ensures that problems are corrected.